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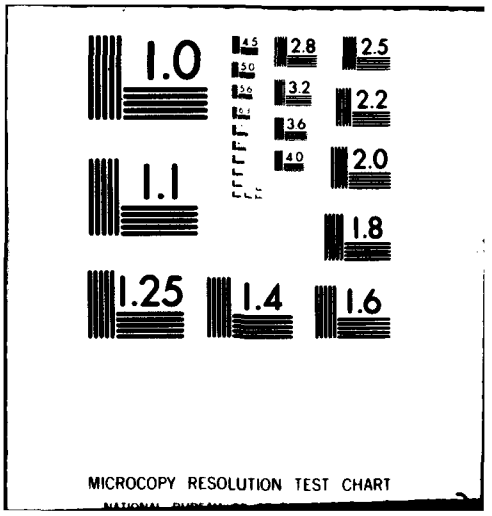
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FTD-ID(RS)T-1553-80

FOREIGN TECHNOLOGY DIVISION

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AEROSPACE SCIENCE AND TECHNOLOGY NEWS

Approved for public release;
distribution unlimited.

EDITED TRANSLATION

FTD-ID(RS)T-1553-80 | 9 December 1980

MICROFICHE NR: FTD-80-C-001154

AEROSPACE SCIENCE AND TECHNOLOGY NEWS

English pages: 7

Source: Hang K'ung Chih Shih, ~~Nov. 5, 1979,~~ ~~pp. 24-25~~

Country of origin: (China)
Translated by: Randy Dorsey
Requester: FTD/TQTA

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FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

AEROSPACE SCIENCE AND TECHNOLOGY NEWS

CAN HYDROGEN BE USED FOR AIRCRAFT FUEL?

Aircraft fuel has consistently depended on petroleum products: gasoline being used for reciprocating engines, and kerosene being used for jet engines. At present, many countries which have inadequate energy resources and petroleum supply problems are investigating new sources of energy. Using hydrogen instead of petroleum for making aircraft fuel is coming to people's attention. In the United States, NASA is in the process of designing a supersonic (Mach 6) aircraft which will use hydrogen for fuel and it is said that design work may be completed in early 1979.

According to a report in the December 1977 issue of the Japanese periodical "Kagaku Asahi" [Science Asahi], the Japanese Aerospace Industry Association, commissioned by the Institute of Industrial Engineering of Japan's Ministry of International Trade and Industry, spent 3 years between 1974 and 1976 investigating the use of hydrogen as an aircraft fuel.

Hydrogen fuel has many advantages. First of all, its raw material, water, is quite plentiful and is available nearly everywhere on earth. Secondly, hydrogen produces more heat than petroleum fuel and therefore aircraft would carry less fuel than before and the aircraft weight could be decreased. Thirdly, by using hydrogen for fuel, noise can be reduced. The aircraft exhausts water and small amounts of nitrogen-oxygen compounds and therefore there is no need to worry about the

atmosphere being polluted. The problems which exist now are: manufacturing costs are relatively high, being twice that of petroleum fuel; and in regard to the safeness of the fuel, the research which has been conducted is still not adequate. It is said that if manufacturing technology improves, by the year 2000 the benefit will be that the price per unit will likely be much lower than that of petroleum fuel which will probably continue to rise from now on.

Hydrogen is flammable and therefore to ensure safety there is still the problem in design of how to deal with the large hydrogen fuel tanks. Japan's Civil Transport Aircraft Development Association plans to work together with the U. S. Boeing Company and engage in international joint development when designing subsequent Y-X transport planes. They are planning on a fuselage which is 52 meters long and if the 2.7 meter diameter, 26.7 meter long hydrogen fuel tanks are mounted inside the fuselage then the fuselage will have to be extended 13 meters and the outward appearance would look rather ugly. If the fuel tanks were to be mounted on the wings, it seems, this would also be possible. By dealing with them this way, even if the hydrogen fuel leaked out it would not affect the safety of the aircrew.

MEMORY ALLOY

In recent years heat deforming alloys of a new type have appeared. They can undergo changes in temperature and change their shape. What particularly surprises people is that if wires of this type of alloy are formed into a certain shape at a given temperature then placed in a high temperature furnace and annealled they are able to "remember" and hold this shape. Afterward the alloy wires are cooled and straightened, and no matter what temperature they are brought to, either lower or higher than the temperature at which they were initially formed, they remain completely straight thoughout. However, they only have to be brought to that predetermined temperature prior to forming and they will immediately return to their original shape. Therefore, these alloys are also called memory alloys. One of them is a nickel-titanium alloy called "Nitinol" which is already used regularly in the areas of medical and aviation manufacturing. For example, wires of this type of alloy are used to make a filter which is annealled then

after being straightened is placed in a low temperature coolant and it will continuously maintain its straight shape. When necessary a wire of this type of alloy can be painlessly and safely inserted into a blood vessel of a thrombotic patient. Under the effects of body temperature the Nitinol "remembers" its original shape, very quickly expands and rolls up into a filter and prevents blood clots from flowing to the lungs. This example illustrates the function of memory alloys.

According to foreign press reports, in a recording device of one American company the indicator needle and recording stylus originally operated by electric motor drive and now uses instead a Nitinol alloy which changes length at different temperatures.

Another laboratory, by taking this alloy and converting the deformation produced by temperature into mechanical motion, 4 years ago built a heat engine which achieved very good efficiency. They are now also building a new type, two-part, one horsepower heat engine which will be very ideal for powering air conditioning equipment.

It is reported that the pipes of the cooling system and hydraulic system of the F-14 fighter use weldless adapters made of Nitinol.

THE SPACE SHUTTLE AND ORBITING ASTRONOMICAL OBSERVATORY

It is reported that the U. S. is planning to use the Space Shuttle to carry a large celestial telescope (with a length of 13 meters and a lens diameter of 2.4 meters) into an orbit 480 kilometers above the earth's surface to set up an orbiting astronomical observatory. The company responsible for the construction is the Lockheed Missile and Aerospace Company. An orbiting astronomical observatory is different from a land-based astronomical observatory. Being outside the earth's atmospheric layer, it is not subjected to atmospheric interference. The resolving power of its celestial telescope will be seven times greater than that of a comparable land-based astronomical observatory.

WINGTIP WINGLETS SAVE FUEL

The KC-135 is an in-flight refueling aircraft which has been used for many years. In order to decrease its own fuel consumption a pair of winglets mounted on top of the wingtips is being tested. All previously conducted tests with wingtip items and tip tanks installed failed to sufficiently reduce the drag of the wing. The structural parts of this pair of top-mounted winglets are made of 2024 and 7075 aluminum alloy, their nonstructural parts are made of epoxy, phenolic aldehyde and polyurethane foam plastic. This winglet is a trapezoid with a length of over 2 meters. It is estimated that with these winglets installed the drag of the aircraft at cruising speed will be reduced by 8%. In total the KC-135 in-flight refueling aircraft will be able to save 45 million gallons of fuel per year. In the future, winglets of this type are likely to be added to the wings of other military and civilian aircraft.

As a result of wind tunnel testing, the winglets may also improve the rate of climb, cruising range and fuel delivery capability.

NEW VTOL AIRCRAFT

A new model VTOL aircraft appeared recently. The XV-15, designed by the Bell Company of the U. S., has already undergone testing. Figure 2 is a drawing of the XV-15. In the drawing the engines are facing upward. They can also face in a horizontal direction. If the aircraft is to be in forward flight the engines are adjusted to the horizontal in the manner of an ordinary airplane. If taking off and landing vertically, the engines are adjusted to an upward facing position, and thus it then becomes a helicopter.

Fig. 2 is a model of an X-wing aircraft developed by the Lockheed California Company. During take off this type of wing is a rotor like that of a helicopter. When it goes into level flight it commences fixed wing operation.

VOYAGER SPACE PROBE FLIES TOWARD JUPITER, SATURN, URANUS & NEPTUNE

According to reports NASA launched the "Voyager 2" space probe on

20 August 1966 and postponed the launching of "Voyager 1" until 5 September due to the occurrence of technical problems. The purpose of launching the present space probe is to observe Jupiter and Saturn and, if all goes well, the carrying out of observations of Uranus and Neptune. In 1972 and 1973, the U. S. launched "Pioneer 10" and "Pioneer 11" to observe Jupiter and Saturn. The "Voyager" space probe launched this time is intended to carry out even more detailed observations. According to plan, the later launched "Voyager 1" will take a quicker route. On 3 March 1979 it will be closest to Jupiter and as a result of being affected by Jupiter's gravity the orbit of "Voyager 1" will begin to curve and it will reach Jupiter (sic*) on 12 November 1980. Voyager 2 will approach Jupiter on 10 July 1979 and will approach Saturn in August 1981.

The above program was formulated by NASA's Jet Propulsion Laboratory. The total number of people carrying out this program are 85 scientific research personnel divided into 11 groups which are responsible for the various observation tasks. Most of the observation technology used is the result of that obtained from observations of Mars, Venus and Mercury as well as new technology of recent development.

The Voyager main body weighs 825kg, including observation instruments weighing 105kg. It power source is different from that of previously launched probes, it does not use solar batteries. This is because the intensity of sunlight on these planets is rather weak. The intensity of sunlight on Jupiter is less than 4% of that on earth and on Neptune it is even less - less than 0.11% of that on earth. Therefore, it has been converted to the use of atomic batteries.

As scientific observation equipment, first of all, television cameras must be used, one with a focal length of 1500mm which is almost identical to, at the same time somewhat improved over the "Mariner 10" camera which observed Mercury. The focal length of the other

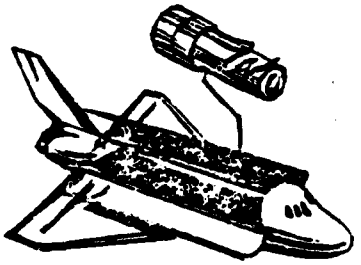
*[Translator's Note: This must be typographical error for Saturn.]

camera is 200mm. The resolution of both of these cameras is relatively high and the photographs it takes should be much clearer than previous ones. The two cameras are designed for eight rolls of film each and it is estimated that they will be able to take color photographs of the planets as well as their satellites.

The space probe will communicate with earth from a very great distance and therefore the antenna used must have high performance. The antenna installed is a large saucer shaped antenna (See Fig. 4) with a diameter of 3.7 meters. In addition there is also a 10 meter long antenna. This is one which is indispensable for radio astronomical observations, which can in addition to detecting the electric waves of planets also observe electric waves of the sun or other celestial bodies. Other observation equipment is: an infrared interference spectrometer, a 51cm diameter reflecting telescope (determines atmospheric composition and temperature of planets and satellites), an ultraviolet spectrometer (measures the atmosphere's ions, atoms and gas molecules), a photopolarimeter, an ion tester and a magnetometer. With the aid of these instruments the behavior of cosmic rays and ions will be observed in detail.

Voyager 2 is expected to reach Uranus on 30 January 1986, take pictures of Uranus and its moons and then fly toward Neptune. After 13 years (i.e., in 1990) it will reach Neptune. As for Voyager 1, NASA has still not stipulated the program for its continuing flight after reaching Jupiter. Both of these space probes will study and photograph four planets and their 12 natural satellites during the long 13 year journey.

Fig. 1.



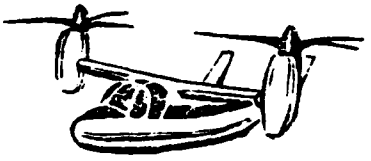


Fig. 2.

Fig. 3.

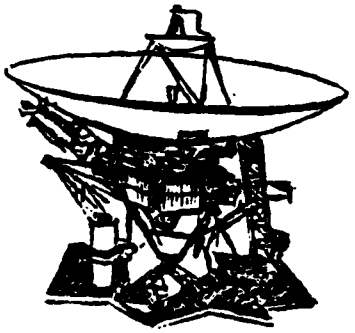
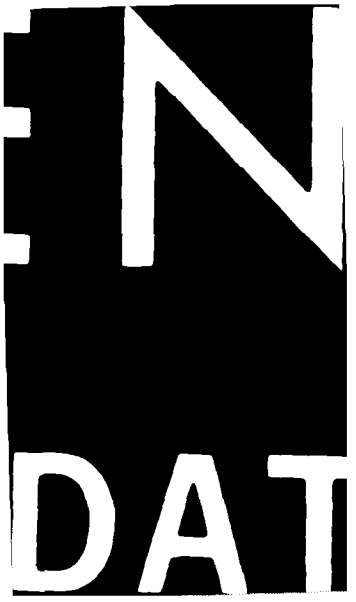


Fig. 4.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